Assignment 14.3 Questions 71-77 odd, 84, 88

71) a. $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ $\quad K_b = \dfrac{[NH_4^+]\,[OH^-]}{[NH_3]}$

b. $C_5H_5N + H_2O \rightleftharpoons C_5H_5NH^+ + OH^-$ $\quad K_b = \dfrac{[C_5H_5NH^+]\,[OH^-]}{[C_5H_5N]}$

73) NH_3 **strongest** $\quad C_5H_5N \quad H_2O$ **$k_b = 10^{-14}$** $\quad NO_3^-$ **weakest (conjugate of a strong acid)**

75) a. $C_6H_5NH_2$ is stronger (ClO_4^- is a conjugate of a strong acid)

b. $C_6H_5NH_2$ $\quad K_b = 3.8 \times 10^{-8} > 10^{-14}$ (K_b for water)

c. OH^- is the strongest base possible

d. CH_3NH_2 $\quad K_b = 4.38 \times 10^{-4} > 3.8 \times 10^{-8}$

77) a. pOH = -log [0.10] = 1.00 $\quad$ pH = 14-1.00 = **13.00**

b. $[OH^-] = 1.0 \times 10^{-10}$ M + 10^{-7} M (from water) = 10^{-7} M

pOH = 7.00 so pH = **7.00**

c. pOH = -log [2.0] = -0.30 $\quad$ pH = 14 - (-0.30-) = **14.30**

84) $K_b = 3.0 \times 10^{-6} = \dfrac{[H_2NNH_3^+]\,[OH^-]}{[H_2NNH_2]} = \dfrac{x^2}{2.0 - x}$ $\quad$ (assume x << 2.0)

$3.0 \times 10^{-6}\,(2.0) = x^2$

$6.0 \times 10^{-6} = x^2$ $\quad [H_2NNH_3^+] = [OH^-] = 2.4 \times 10^{-3}$ M

$x = 2.4 \times 10^{-3}$ M $\quad [H_2NNH_2] = 2.0 - 2.4 \times 10^{-3} = 2.0$ M

pOH = -log [2.4×10^{-3}] = 2.62 $\quad$ pH = 14 - 2.62 = **11.38**

88) $K_b = 1.3 \times 10^{-3} = \dfrac{[(C_2H_5)_2NH_2^+]\,[OH^-]}{[(C_2H_5)_2NH]} = \dfrac{x^2}{0.050 - x}$

$1.3 \times 10^{-3}\,(0.050\text{-}x) = x^2$

$6.5 \times 10^{-5} - 1.3 \times 10^{-3}\,x = x^2$ $\quad$ pOH = -log [0.0074]

$6.5 \times 10^{-5} - 1.3 \times 10^{-3}\,x - x^2 = 0$ $\quad$ pOH = 2.13

$x = 0.0074$ M $\quad$ **pH = 11.87**

$[OH^-] = 0.0074$ M